



PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to clothes driers

We, BORG-WARNER CORPORATION, a corporation organised under the laws of the State of Illinois, United States of America, of 310 South Michigan Avenue, City of Chicago, State of Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates, in general, to laundry apparatus, and has particular reference to a clothes drier advantageously applicable for domestic use in homes, apartment buildings and self-service laundries.

More specifically stated, this invention is embodied in an automatic clothes drier of the type employing a revolving cylinder in which clothes are effectively tumbled and subjected to a large volume of air passing through said cylinder by mechanical means, whereby said clothes are dried to a degree ranging from the wet condition of the clothes when disposed in the drier to complete dryness, ready to wear, dependent upon the drying time selected by the operator.

In order to facilitate the drying of clothes and particularly clothes which have been washed by a conventional washing machine, it is desirable not only to remove the surplus water from the clothes such as may be done by a centrifugal extractor, but it is also desirable to further dry the clothes by circulating air thereover and therethrough; the air so circulated may be either warmed by a heater or may be air of room temperature under certain conditions to favourably effect drying of the clothes.

According to the invention, there is provided a clothes drier including a rotatable clothes-receiving drum having a substantially imperforate cylindrical shell open at one end for the insertion and removal of the clothes, the other end of the drum being closed by a wall which is formed to define a plurality of air scoops around an annular

air chamber formed by axially spaced portions of the wall, each air scoop having an inlet opening for establishing communication between the annular air chamber and the interior of the drum, whereby upon rotation of the drum in a predetermined direction the wall scoops a number of separate air streams from the annular air chamber into the interior of the drum.

Embodiments of the invention are illustrated in the accompanying drawings forming a part thereof and wherein:

Fig. 1 is a perspective view of a clothes drier embodying the features of the present invention;

Fig. 2 is a front elevational view of the interior of the drier cabinet depicted in Fig. 1 with the front panel thereof removed and parts thereof being shown in section to more clearly illustrate the construction thereof;

Fig. 3 is a rear elevational view of the drier depicted in Figs. 1 and 2 with the back panel thereof being shown broken away in order to more clearly illustrate the construction of the internal parts;

Fig. 4 is a sectional view of the drier depicted in Figs. 1, 2 and 3 and being taken substantially on the plane of the line 4-4 in Fig. 1;

Fig. 5 is a plan sectional view of the drier contemplated herein and being taken substantially on the plane of the line 5-5 in Fig. 2;

Fig. 6 is a partial sectional view of the light structure for illuminating the interior of the drum, this view being taken substantially on the plane of the line 6-6 in Fig. 8;

Fig. 7 is a sectional view through the rotatable drum drive shaft and supporting means therefor and including mounting structure for the air fan contemplated by this invention;

Fig. 8 is a fragmentary sectional view of the cabinet adjacent the access opening to illustrate the relative disposition of the parts

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thereof, this view being taken substantially on the plane of the line 8-8 in Fig. 1:

Fig. 9 is a perspective view of the rear wall of the rotating drum and illustrating relative disposition of the openings which permit entry of the air into the drum;

Fig. 10 is a fragmentary sectional view of the lower regions of the cabinet of the drier depicted in Fig. 1 illustrating the vent and lint screen access door, this view being taken substantially on the plane of the line 10-10 in Fig. 1;

Fig. 11 is a fragmentary sectional view of the lower regions of the cabinet of the clothes drier depicted in Fig. 1 and illustrating the relative disposition of the lint trap with respect to adjacent parts of the clothes drier;

Fig. 12 is a fragmentary elevational view of a drum lock contemplated by this invention effective to lock said drum for stationary drying without tumbling;

Fig. 13 is a sectional view of the drum lock depicted in Fig. 12 and being taken substantially on the plane of the lines 13-13 in Figs. 2 and 12;

Fig. 14 is a top plan view of the drying time control mechanism contemplated by the present invention;

Fig. 15 is a front elevational view of the timing mechanism depicted in Fig. 14, but with the front panel thereof being removed to more clearly illustrate the construction thereof, this view being taken substantially on the plane of the line 15-15 in Fig. 14;

Fig. 16 is a sectional view of the timing mechanism depicted in Figs. 14 and 15 and being taken substantially on the plane of the line 16-16 in Fig. 15;

Fig. 17 is a front elevational view of the front panel of the timing mechanism illustrated in Figs. 14, 15 and 16 and having indicia inscribed thereupon to facilitate selection by the user of a required drying time; and

Fig. 18 is an electrical wiring diagram for the drier contemplated by this invention.

The drawings are to be understood to be more or less of a schematic character for the purpose of illustrating and disclosing a typical or preferred form of the improvements contemplated herein, and in the drawings like reference characters identify the same parts in the several views.

In the exemplary embodiment of the invention depicted in Figs. 1, 2, 3, 4 and 5, the drier contemplated by this invention comprises, in general, the component part assemblies respectively indicated in their entirety by the letters as follows: A cabinet A exemplifying the external appearance of the automatic drying machine as shown in Fig. 1 and being hereafter referred to simply as a "clothes drier"; a clothes drum B disposed within the cabinet A and revolvable on a substantially horizontal axis and

effective to tumble the fabrics disposed therein; an air moving fan assembly C axially disposed with respect to the drum B and effective to cause a relatively large volume of air to pass through said drum B for contact with the fabrics disposed therein for absorption of moisture, whereupon said moisture is conveyed outwardly and away from the machine with said air; a driving mechanism assembly D effective to cause rotation of said drum B and said air moving fan assembly C; a static dry control E associated with said drum B and effective to control rotation or non-rotation of said drum responsive to manual operation of said static dry control means by the user as desired; an air heating assembly F over and through which ambient air is drawn by said air moving fan assembly C effective to raise the temperature of said ambient air before entry thereof into said drum B whereby said air will be more effective to absorb moisture in the fabrics contained in said drum B; a lint trap assembly G effective to filter out lint contained in the air passing from said clothes drum before it is discharged from the drier to provide substantially lint-free air at the discharge openings; air discharge ports H providing a 5-way vent system permitting flush-to-wall installation in any location without special fittings and whereby said drier may be vented from left or right sides, from rear or bottom of the cabinet, or direct exhaust through the front of the machine by tipping the hinged base panel to a desired open position; a supporting structure I for the operating mechanism disposed within the cabinet and including support means for the driving mechanism assembly D; and a timer mechanism J adapted to regulate the operation of the drier with respect to a selected drying time and permitting selection by the user of drying only by air or by air with heat, the timer mechanism J including the selector switch cooperating with said static dry control means E whereby the user has fingertip choice of drying fabrics (1) by employing heated air, or (2) air alone, (3) with the drum revolving or (4) maintained in a static condition by operation of the static dry control means E as selected by the user.

THE CABINET A

Attention is directed to Fig. 1 wherein there is illustrated the cabinet A which houses the entire mechanism and control system therefor and which comprises a cover 20, a front panel 21, side panels respectively indicated at 22 and 23, and a control panel 24 forming a part of and projecting upwardly from the cover 20 as illustrated in Figs. 1, 2 and 4.

In Figs. 1 and 4, it can be seen that the front panel 21 is provided with a hinged door 24 to form the closure member for an

opening 26 through which clothes or other fabric articles to be dried may be introduced to the machine. The hinged door 25 is so disposed with respect to the opening 26 that it will be flush with the surface of the front panel 21 when it is in its closed position. One or more metal straps 27 pivotally disposed in mountings secured to the inside surface of the front panel 21 serve to provide a hinged mounting for the access door 25 with respect to the front panel 21.

On the left-hand side of the control panel 24 there is disposed a control switch knob 30 which provides a means for manually selectively controlling (1) air dry or (2) air dry with heat, as desired by the user. The construction and operation of the control switch 30 will be more fully described hereinafter.

On the right-hand side of the control panel 24 there is disposed a control knob 33 which provides a means for manually regulating the timer J. The length of the drying cycle may thus be predetermined and set within certain limits by the manual adjustment of the control knob 33 in a manner to be described in detail hereinafter.

It is notable that both the control switch 30 and the control knob 33 are shown as being disposed on the panelled surface 24 so that they provide no obstruction to the operator in the use of the top surface 20 or in the introduction of the articles to be dried to the machine, or their removal therefrom.

Particular attention is directed to Fig. 1, wherein there is clearly illustrated a recess 35 arranged adjacent the back portions of the drier cabinet, this recess being adaptable for convenient receipt of pipes, wiring cables and the like so that the rear portions 36 of the top of the cabinet A may be positioned so as to be in engagement with a wall or the like to provide continuity when the drier is disposed in kitchen and/or laundry cabinet arrangements and yet provide, by means of the recess 35, for accommodation of obstructions running horizontally along the wall which could be supply pipes and/or electrical conduits and the like.

An angularly disposed recessed toe plate 37 is provided in the lower front portions of the cabinet as shown in Figs. 1, 4, 10 and 11. This also is to provide obvious advantages of utility, and yet giving design considerations to uniformity when the drier is disposed in a kitchen and/or laundry cabinet arrangement. Moreover, the recessed toe plate 37 is hinged to the lower regions of the cabinet A and is movable between opened and closed positions respectively illustrated in dotted lines and in full lines in Fig. 10. The opening of said recessed toe plate and lint trap access door 37 provides one of five

possible means for venting the drier and will be more fully described hereinafter.

THE SUPPORTING STRUCTURE I

Attention is now directed to Figs. 2, 3, 4 and 5, wherein there is clearly disclosed the structural support I which comprises a base formed of sheet steel members indicated in their entirety by the numeral 40 and suitably formed and interconnected by welding or the like to define a substantially box-like base having disposed at the four corners thereof suitably adjustable legs as at 50 adaptable to provide a levelling means for the drier when placed in operative position on a floor or the like, and a superstructure formed of suitably bent sheet steel member 51 arranged vertically to provide a supporting structure for portions of the driving mechanism assembly D and the air heating assembly F.

It can be seen in Figs. 2, 3 and 4 that the lower portions of the cabinet A are secured to and supported by the members 40 of the base. Thus, it can be seen that the supporting structure I is a relatively self-contained unit, and is constructed so as to place the centre of gravity in the lower portions of the drier which is to provide advantageous stabilization of the drier in operation, thereby to reduce noise and objectionable vibration to the minimum.

THE CLOTHES DRUM B

An important feature of the present invention is the revolving drum B in which clothes are effectively tumbled and subjected to a large volume of air passing through said drum by operation of the air moving fan assembly C to be hereinafter described in detail, whereby said clothes are dried to a degree ranging from the wet condition of the clothes when disposed in the drier to complete dryness, ready to wear, dependent upon the drying time selected by the operator.

It is important to note that it is highly desirable in clothes driers of the class contemplated herein to provide a drum effective to cause advantageous tumbling of the clothes so that the air passing through the drum advantageously wipes the clothes to more efficiently remove the moisture content therein, thereby providing and assuring safe, fast, uniform drying for every fabric.

In this connection, particular attention is invited to Figs. 2, 4, 7 and 9, wherein the drum B contemplated by the present invention is set forth in detail. It comprises, in general, a cylindrical metal shell 60 made of a solid, imperforate piece of metal in contrast to the usual wire mesh screen heretofore employed, this imperforate construction preventing accumulation of lint which has

always been present in perforated cylindrical drums. A forward drum end 61 is suitably secured to the front end of the cylindrical shell 60 and has a portinn which is bent over the cylindrical shell 60 to define a tire 62. The front drum end 61 defines a curved ring 63 provided with a flange 64 extending radially inwardly towards the axis of the cylindrical shell 60. The rear end 65 of the drum has a central aperture 66 defined by an inturned flange 67. The rear end 65 of the drum has secured thereto an offset wall 68 projecting into the cylindrical shell 60 and defining a chamber or cavity 69 adapted to accommodate portions of the air moving fan assembly C. The offset wall 68 has axially extending, spirally curved segmental baffle portions 70, 71 and 72 which together with the shell 60 form three air scoops 70a, 71a and 72a, each respectively having an air inlet opening as at 73 which is in communication with the annular chamber 69 and the interior of the shell 60. The latter supports baffle means as at 74 and 75 effective to pick up clothes and carry them upwardly during rotation of the drum until a high point is reached whereupon the clothes are dropped to the lower portions of the cylinder and are picked up by another baffle to repeat this cycle.

In order to further reinforce the rear end of the drum, there is provided the conically-shaped depressed portions 78 providing a mounting means for a hub 79 which is secured to the conically-shaped portions 78 by means of bolts such as at 80. The hub 79 is provided with a central through aperture 81 adapted to receive a driven shaft 82 having an axially extending groove 83 disposed on the periphery thereof, said groove being adapted to receive end portions 84 of a set screw 85 received into a threaded aperture 86 in said hub 79, thereby maintaining said shaft 82 in fixed relationship with respect to the hub 79 which is carried in fixed relationship with respect to the conical-shaped portions 78 forming a part of the rear wall of the drum B.

As may best be seen in Figs. 2, 4 and 8, the flange 64 of the drum B has a plurality of apertures as at 90 in an annular array as shown, these apertures being in open communication with an air chamber 91 which surrounds the access opening 26 to provide an air conduit directing moisture and lint laden air toward the lint screen G. The chamber 91 is formed of sheet metal plates to define a relatively air-tight conduit.

It is notable that the air chamber 91 remains stationary while the flange 64 rotates with the drum B. In order to effectively seal these relatively movable parts, there is provided a felt seal 94 fixedly secured to an outside surface of the air chamber 91 by means of a clamp 95 so that the projecting end of the annular felt seal 94

is in intimate engagement with portions of the curved ring 63, thereby providing an effective air seal between these movable parts.

In order to further seal the chamber 91, there is provided an annular felt seal 96 carried by an annular flange 97 integral with the flange 64 whereby said seal will remain stationary while the drum B rotates.

The opening 26 in the front panel 21 is formed to define a plurality of panels 100, 101 and 102. In Fig. 8 it can be seen that the access door 25 comprises inner and outer panels respectively indicated at 105 and 106, these panels being suitably bent to define flanges respectively indicated at 107 and 108 which are suitably welded or otherwise secured to provide an integral door. As may best be seen in Fig. 1, the door is of a substantially square shape. Accordingly, portions of the opening 26 adjacent the flanges 107 and 108 of the door 25 are of a substantially square shape in order to accommodate the door as shown in Fig. 8. The panels 100, and 101 and 102 define parts of the opening 26 which are of a generally circular shape.

Arranged to fit and be attached to the annular circular-shaped portions of the opening 26 is a seal 110 formed of rubber or the like and having portions 111 adapted to engage the inner panel 102 of the door 25. Secured to the upper regions of the annular seal 110 is an illuminating lamp fixture 113 adapted to provide suitable illumination in the drum B so that the user can readily identify the fabrics disposed therein. The lamp is controlled by a door switch 114 (Fig. 1) which is spring pressed to a normally closed position and upper left-hand portions of the door 25 are adapted to engage a plunger of the switch 114 upon closing of the door which will cause said switch to be opened and the current to the lamp 113 will be interrupted to shut off the lamp. Upon opening the door 25, the switch will be closed by virtue of the spring means disposed therein, thereby to light the lamp 113 so that the user may conveniently view the inside of the drum.

As may best be seen in Figs. 4 and 9, the air openings 73 each is provided with a U-shaped wire 115 secured to the wall 68 by means of screws or rivets as at 116 to provide an obstruction preventing clothes or fabrics disposed in the drum from entering into the opening 73.

Thus, it can be seen that the drum B is cylindrical in form defined by the imperforate cylindrical wall 60 and is provided with new and improved air entry means comprising the openings 73 and the spiral baffles 70, 71 and 72 which effectively cooperate with the cylindrical wall 60 to efficiently distribute the air throughout the cylinder for advantageous contact with the

clothes disposed therein, whereby to more rapidly and efficiently cause absorption of moisture by the air to assure rapid, safe and effective drying of the fabrics.

5 DRIVING MECHANISM ASSEMBLY D

10 An important feature of the present invention is the improved driving mechanism assembly D which is operable to cause rotation of the drum B and to drive the air moving fan assembly C, to be hereinafter more fully described; the drive arrangement contemplated herein does not require the use of internal gear segments, gears and racks or shafts having special cranks formed thereon, or other complicated or expensive mechanical parts, but which is made up of parts simply and cheaply manufactured and assembled and adapted to be applied to and used with straight shafts to accomplish smooth, quiet and efficient operation.

20 It is important to note that it is highly desirable in clothes driers of the class contemplated herein to provide a drive mechanism which is quiet in operation and has a minimum of vibration.

25 In this connection, particular attention is invited to Figs. 2, 3, 4 and 7, wherein the driving mechanism assembly D contemplated by the present invention is set forth in detail and may comprise, in general, an idler wheel 120 having a shaft 121 suitably journaled in and carried by the support plate 40 of the supporting structure I and so arranged that the periphery of the wheel 120 is in intimate engagement with the tire 62, the driven shaft 82 as hereinbefore described, a drive pulley 130 mounted on the shaft 125 remotely from the wheel 124, a drive pulley 132 rotatably mounted on the driven shaft 82 (Fig. 7) for relative rotation therebetween, a drive pulley 133 mounted on a drive shaft 134 of an electric motor 135, and an endless V-belt 138 suitably mounted on the drive pulleys 130, 132 and 133 as shown in Fig. 3.

40 The motor 135 is carried by a bracket 136 which is hinged as at 137 to a supporting bracket 138 secured to the lower frame structure of the drier. A spring 139, one end 140 of which being attached to portions of the bracket 136 and the other end 141 of which is secured to the lower frame assembly of the clothes drier, provides a resilient force urging pivotal movement of the motor in a generally downwardly direction in order to facilitate at all times proper tension of the V-belt 138 in its driving contact with the drive pulleys 130, 132 and 133.

50 Attention is invited to Fig. 7 which is an enlarged view of portions of the driving mechanism assembly D. It can be seen that the shaft 82 is fixedly secured to the drum B and is rotatable therewith by means of the set screws 85 disposed in the hub 79

70 which is carried by portions of the rear wall of the drum B. Carried by the vertical support 51 is a bracket 145 adapted to support a scintered powdered metal bearing 146 in which outer end portions 147 of the shaft 82 are effectively journaled. In order to prevent relative axial movement of the shaft 82 with respect to the bearing 146 there is provided a washer 148, and a snap ring 149 disposed in a groove 150 in the shaft 82. 75

80 As may best be seen in Fig. 7, the air moving fan assembly C is mounted upon the shaft 82 for relative rotation therebetween. It is notable that the shaft 82 will rotate in one direction while the fan assembly C will rotate in the opposite direction. In order to accomplish this there is provided a bronze bearing 155 having a rubber sleeve 156 encased in a suitable cover or case 157. In like manner, there is also provided a second bronze bearing 160 having a rubber sleeve 161 encased in a cover or case 162. It is notable that the bearings 155 and 160 are disposed in spaced relationship. Surrounding the shaft 82 in the space between the bearings 155 and 160 there is disposed an oil-soaked wick felt 165 arranged to co-operate with the oil grooves 166 and 168 in the shaft 82 so that lubrication is effectively provided to the bronze bearings 155 and 160. Adjacent the end portions of the bearings 160 there is disposed a felt seal 167 maintained in its proper position as shown by a snap ring 168 encased in a housing 169 and operable to effectively prevent lubrication from running axially along and outwardly of said shaft 82. 90 95 100

The drive pulley 132 is mounted on a hub 175 by means of bolts as at 176 which also secure to the hub 175 an annular fan blade support 177 having attached thereto adjacent the periphery thereof projecting blades as at 178, 179, 180, 181. It is notable that the hub 175 is suitably journaled on the shaft 82 by means of the bearings 155 and 160.

105 Attention is invited to Figs. 2, 3 and 4, wherein it can be seen that the drum B is supported for rotation on the wheels 120 and 124, the peripheries of which are in engagement with the tire 62 so that the drum B may effectively rotate thereon. In Fig. 2 it can be seen that the wheel 120 is an idler wheel and is not driven by the driving means but merely acts as a support for the drum B. However, the wheel 124 is driven through the shaft 125 by means of the pulley 130 which is caused to rotate by means of the V-belt 138 (Fig. 3), which in turn is rotated by the drive pulley 133 attached to the motor shaft 134. Accordingly, because the drier drum B rests upon the wheel 124, the drum will be caused to rotate by rotation of the wheel 124, thereby to drive the drum to effectively tumble the fabrics contained therein. 115 120 125 130

In Figs. 3, 4 and 7, it can be seen that the rear end of the drum is supported by the centrally disposed shaft 82 which is journaled in the scintered powdered metal bearing 146. Because the shaft 82 is fixedly secured to the drum B, it will rotate therewith and act as a driven shaft, the rotation of the drum being accomplished by rotation of the wheel 124.

Because the driving mechanism for the drum B is inter-related with the driving mechanism of the air moving fan assembly C, it can be seen that when the drum rotates the air moving fan assembly will also be operative. Movement of the endless V-belt 138 will cause rotative movement of the pulley 132 and, because the pulley 132 is secured to the hub 175 which in turn carries annular fan blade support 177, the air moving fan assembly C will be caused to rotate.

AIR HEATING ASSEMBLY F

Another important feature of the invention contemplated herein is the provision of an improved air heating means generally indicated in its entirety by the letter F.

Attention is invited to Figs. 3 and 4, wherein it can be seen that the air heating assembly F comprises, in general, a housing 200 formed of metal plates to define the shape as shown and to provide a baffle 201, whereby to control the flow of ambient air for passage over and through an electric heating element 202 suitably carried in a sheet metal frame 203 which is attached to the vertical support 51, the sheet metal frame 203 being formed to define a tunnel-like shape with the electric heating elements as at 202 disposed therein. Ambient air is drawn by the air moving fan assembly C through a plurality of apertures as at 205 disposed in the rear enclosure panel 206 in the direction indicated by the arrows, and through the opening 207 in the upper regions of the cabinet for passage into the housing 201 and through the tunnel-like shaped enclosure 203 for contact with the heating elements 202 and thereafter through an aperture 208 in the vertical support 51.

Thus, the ambient air coming in contact with the heating elements 202 will be raised in temperature for more effective absorption of the moisture contained in the fabrics disposed in the drum.

Although an electric heating element 202 is disclosed herein, it is obvious that other means may be employed for air heating such as, for example, gas or the like.

The control of the operation of the heating elements 202 will be further discussed hereinafter in detail in the description of the wiring diagram illustrated in Fig. 18.

It is important to note that this invention contemplates a drier having relatively low operating temperatures ranging from 110°F.

to 140°F., the moisture in the fabrics when first deposited in the clothes drier being effective to maintain the operating temperature at 110°F. and as the moisture is withdrawn from the fabrics to a point where 90 per cent of the moisture has been removed from the fabrics, the temperature range will rise to approximately 140°F. and a control means to be hereinafter described will be effective to cause inoperation of the heating means while the drum continues to rotate to tumble the clothes for effective fluffing thereof and the air continues to pass thereover and therethrough to effectively aerate the fabrics for whatever length of time to which the timer has been set.

THE AIR MOVING FAN ASSEMBLY C

Another important feature of the invention contemplated herein is the provision in a drier of the general class disclosed herein of an air moving fan assembly indicated in its entirety by the letter C and disposed axially of the drum and of a relatively large size to provide an unusually large volume of air for passage through the drum B for contact with the moisture laden clothes disposed therein, whereby to absorb the moisture contained in the clothes and to carry the same outwardly of the drum through the lint trap G where any lint in the air is filtered therefrom, and outwardly of the cabinet through one of five possible vent openings H.

As may best be seen in Figs. 4 and 5, the air moving fan assembly C comprises the annular support 177 having fixedly disposed adjacent the periphery thereof a plurality of fan blades 178, 179, 180 and 181, these fan blades being arranged in equally spaced relationship and disposed in the chamber 69 defined by the rear end wall assembly of the drum B.

It is notable that the drum B will rotate in one direction while the fan assembly C will rotate in a direction opposite to that of the drum. Thus, rotation of the fan assembly C effected by rotation of the pulley 132 by means of the endless V-belt 138 through the motor drive pulley 133 will cause ambient air to be drawn through the aperture 205 in the back panel 206 and through the opening 207 in the upper regions of the cabinet for passage through the housing 201 and in the tunnel-like shaped enclosure 203 for contact with the air heating elements 202, through the opening 208 in the vertical support 51 and through the annular opening 220 in the rear wall 65 of the drum B for passage through the openings 73 and into contact with the fabrics in the drum B where the air will absorb moisture contained in the fabrics and will be forced outwardly from the drum through the openings 90 in the flange 64 at the forward end of the drum for discharge

into the air chamber 91 for transmittal to the lint trap assembly G disposed in the lower regions of the cabinet and thereafter outwardly from the cabinet via one of five possible vent openings H.

It is important to note that the vertical support 51 is provided with an annular opening 222 (Fig. 4) through which the shaft 82 and the assembly disposed thereupon projects, this opening permitting ambient air of room temperature to be drawn into the chamber 69 by the fan where the ambient air is mixed and co-mingled with the heated air entering into the chamber 69 via the opening 208. The passage of ambient air of room temperature around and adjacent the driving assembly and the bearings disposed adjacent the opening 222 provides an effective means for cooling the bearings hereinbefore described and located in this general region.

Moreover, it is of particular importance to note that the air flow is constantly away from the heating elements 202 which advantageously provides safety in operation and substantially eliminates any questions of fire hazards. Moreover, the relatively large volume of air afforded by the operation of the air moving fan assembly C slightly pressurizes the drum B, whereby contact of the air with the fabrics contained in the drum is effected more efficiently and more completely whereby moisture from the fabrics is more rapidly absorbed to effect drying of the fabrics quickly but at a relatively low temperature which is safe for even the daintiest fabrics.

STATIC DRIVE MECHANISM E

In one of its aspects the present invention contemplates the provision of means whereby the operator may conveniently and advantageously cause non-rotation of the drum B in order to dry certain fabrics which would be damaged by the usual tumbling action universally employed by clothes driers. The operator may select by manual operation of the heat control switch knob 30 to have either air dry or air dry with heat. By operating the static dry control means E, the operator may further select whether the drum should rotate or be maintained in a stationary position.

Attention is invited to Figs. 2, 12 and 13, wherein there is disclosed the static dry control mechanism generally indicated by the letter E and which may comprise, in general, a manually operable control handle indicated in its entirety by the numeral 230 and rotatably mounted in the support 40, a first bracket 231 fixedly secured to said support 40, a second bracket 232 hingedly mounted to said first bracket, an operating lever 233 one end of which is pivotally connected to the second bracket 232 by means of a pivot pin 234 and the other end

235 of which is adapted for engagement with the tire 62 surrounding the periphery of the basket B, and a third bracket 236 also fixedly secured to the support 40 and adapted to act as a guide for the upper end regions of the operating lever 233.

It can be seen in Fig. 13 that the operating handle 230 comprises the handgrip 240 which is suitably mounted on a screw threaded shaft 241 adapted to be received into a nut 242 welded or otherwise secured to the first bracket 231 as shown. Accordingly, manual rotation of the handle 240 will cause axial movement of the screw threaded portions 241. In order to prevent removal of the screw threaded portions 241 from its operative position with respect to the nut 242, there is provided a washer 243 which will become engaged with the exposed surface of the nut 242 responsive to rotation of the handle 240 in a direction whereby the screw threaded portions 241 will be caused to move outwardly of the nut 242.

It is notable that the end portions 244 of the screw threaded portions 241 are engageable with the second bracket 232 and manual rotation of the handle 240 in a direction whereby the screw threaded portions 241 are moved inwardly of the nut 242 will force pivotal movement of the second bracket 232 with respect to the first bracket 231 on an axis defined by the pivot pin 245 and, because of the pivotal interconnection between the second bracket 232 and the operating lever 233 by means of the pivot pin 234, the operating lever will be caused to move upwardly, whereby the upper end portions 235 will become engaged with the tire 62 of the drum B, whereby said drum will be raised slightly from its normal engagement with the drive wheel 124 and thereby remain stationary while the drive wheel 124 continues to rotate.

Manual operation of the handle 240 in a direction whereby the screw threaded portions 241 will be moved axially outwardly of the nut 242 will cause the second bracket 232 to assume its normal position and because of this movement the operating lever 233 will be moved downwardly to a normally disengaged position with respect to the end portions 235 and the tire 62 of the drum B. It is notable that the weight of the drum B will cause said downward movement when permitted by rotation of the handle 240.

It can be seen in Fig. 13 that the first bracket is of a generally U-shape and is fixedly secured to the support 40 by means of screws as at 250.

The second bracket is also of a generally U-shape and of a dimension somewhat smaller than the first bracket 231 so that the second bracket 232 will fit into the confines of the generally U-shape of the first bracket 231. The pivot pin 245 pivotally

interconnects the second bracket 233 with respect to the first bracket 231.

In Figs. 12 and 13 it can be seen that the third bracket 236 is fixedly secured to the support 40 by means of a screw as at 251. This bracket is provided with a depending flange 252 projecting away from the support 40 and is provided with an aperture 253 adapted to receive the upper end regions of the operating lever 233. It is notable that the third bracket 236 acts as a guide for the upper regions of the operating lever 233 so as to assure proper contact between the upper end 235 of the operating lever 233 and the tire 62 of the drum B.

In order to provide access to the handle 240 the lint trap access door 37 may be pivoted to its open position and the operator can then manually rotate the handle 240 to effect either static dry or drying of the fabrics by rotation of the drum which will tumble the fabrics contained therein. A more detailed description and operation of the lint trap access door 37 will be set forth hereinafter.

THE LINT TRAP ASSEMBLY G

An important feature of the present invention is the lint trap assembly G set forth in detail in Figs. 2, 4, 5, 10 and 11. It is notable that the air chamber 91 opens into a rectangular-shaped box-like structure defined by the walls 275, 276, 277 and 278, wherein there is disposed a removable lint trap 279 comprising a rectangular-shaped metal frame 280 having fitted therewith a screen 281 adapted to filter out lint contained in air passing therethrough in the direction indicated by the arrows in Fig. 11.

The side walls of the box-like structure are fitted with angle-type flanges 285, 286 (Figs. 4 and 5) adapted to support the frame 280 of the lint trap 279.

As may best be seen in Fig. 4, the lint trap access door 37 is mounted adjacent the lower regions of the cabinet so that said lint trap access door 37 may be moved between open and closed positions respectively indicated in dotted and full lines in Fig. 10. In order to accomplish this pivotal movement, there is provided a hinge 290 whereby the lint trap access door 37 is hingedly mounted to the lower regions of the support frame.

Attention is invited to Fig. 10, wherein there is provided a spring 291, one end 292 of which is secured to a projecting flange 293 of the lint trap access door 37 and the other end of which is suitably secured to the cabinet structure, whereby said lint trap access door 37 is maintained in its normal closed position shown in full lines in Fig. 10. In the event that it is desirable to maintain the lint trap access door in its open position shown in dotted lines in Fig. 10, there is provided a lever 294 mounted in

the upper regions of the lint trap access door 37 for pivotal movement by means of the rivet 295 so that projecting end portions 296 may become engaged with the support 40, thereby to maintain said lint trap access door 37 in its open position in dotted lines in Fig. 10. The lint trap access door 37 is maintained in this open position in the event it is desirable to have the drier vented through this door.

It is notable that there are four other possible vent openings which will be hereinafter described. When the lint trap access door 37 is in its closed position the lever 294 is pivoted around the rivet 295 and maintains its position shown in full lines in Fig. 10.

For purposes of cleaning lint from the lint screen 281, the lint trap access door 37 may be opened and the lint trap removed from its normal position in the box-like structure defined by the walls 275, 276, 277 and 278. After cleaning, the lint trap will again be placed in its normal operating position as shown in Fig. 11.

After the lint-laden air from the air chamber 91 passes through the screen 281 the lint-free air will travel rearwardly of the lower regions of the cabinet in the direction indicated by the arrows in Fig. 11 and pass through an opening 300 for entry into a cylindrical conduit 301 disposed at right angles to the opening 300 and adapted to convey the air to each side of the lint trap adjacent the respective sides of the cabinet to the venting means to be hereinafter described in detail.

AIR DISCHARGE EXHAUST PORTS H

The clothes drier contemplated herein is designed and equipped with provisions so that the moist heat laden air can be exhausted in any one of five different directions.

Particular attention is invited to Figs. 1, 4, 5 and 11, wherein there are disclosed the air discharge exhaust ports H. On the left or right side of the cabinet near the rear of the drier two knock-outs as at 325 are provided in either side of the cabinet through which a standard flue pipe can be inserted for making connections to exhaust outlet 301 at the rear of the drier. These two connections provide for below ground level basement installation with the cabinet flush to the wall.

With the use of an elbow, exhaust may be installed directly in the back 206 of the drier for utility room installation. This also provides flush-to-the-wall installation. An oblong knock-out 326 (Fig. 5) is provided in the lower left centre of the cabinet back panel to accommodate an exhaust pipe 327.

Two knock-outs 328 and 329 are located underneath the drier near the front to provide a means for installing the exhaust

down through the floor for inside wall installation. These two knock-outs are staggered and either one may be used to eliminate interference from floor joists.

5 Exhausting can be directed into the room through the front of the drier by tilting the lint trap access door 37 to its open position shown in dotted lines in Fig. 10. This method may be used in some installations because of its simplicity.

10 The above five methods eliminate any special parts or kits because standard galvanized or aluminum pipe or fittings can be purchased in most hardware stores or tin shops. In many cases, installation of exhaust piping can easily be made by the user.

15 Indoor exhausting of the moisture-laden air is satisfactory when the laundry room is large and airy or when cross ventilation is possible by means of two open windows or an open window or door, or when an exhaust fan is used in the laundry. However, for permanent installations or installation in a small unventilated room, it is desirable to conduct the moisture-laden exhaust to the outside of the house in which the drier is installed.

TIMER MECHANISM J

30 An important feature of the invention is the provision of the timer mechanism J having incorporated therein a linearly arranged dial to provide convenient reading and styling having appeal to the aesthetic senses of the user.

35 Particular attention is invited to Figs. 1, 2, 14, 15, 16 and 18, wherein the timer mechanism J is set forth in detail and may comprise, in general, a support frame 350 formed to define the shape as shown and adapted for securement to the inside surface of the backboard panel of the cabinet A, a selector switch 351 carried by said frame and connected in circuit with the heating means 202 whereby the operator may select operation of the drier by air alone or air with heat, a timer motor 352 carried by said frame 350 and adapted for regulating timed operation of the drier responsive to a time interval selected by the user, a dial 353 (Figs. 14 and 17) formed of a translucent material and having indicia inscribed thereupon indicating timed intervals of drier operation, said dial being linearly arranged and carried by a recessed opening 354 disposed in the backboard panel of the cabinet A, and linearly movable indicator means 355 movable along the linear path described by the indicia in the dial 353, and said indicator means 355 having associated therewith drive means 356 operable by said timer motor 352 to move said indicator means 355 along said linearly described path.

65 As may best be seen in Figs. 14, 15 and 16, the selector switch 351 is controlled by

the selector switch control knob 30 which projects outwardly of the dial 353 for convenient access thereto by the operator. The operator will move said control knob 30 to one of two positions, namely, to "Air" or "Heat" (Fig. 17) which respectively provides operation of the drier with air alone or air with heat. Associated with said selector switch 351 and disposed behind the dial 353 there is provided an illuminating lamp 358 which will indicate visually the position of the switch knob 30. Attached to the frame by means of a bracket 359 is an elongated illuminating lamp 360 effective to light up the dial 353. The indicator means 355 is formed to define a generally elongated pointer-like shape 361 and this pointer is positioned and arranged so as to blank out a portion of the light from the lamp 360 to cause a shadow-like configuration marking off its respective position of the dial 353.

The control knob 33 is mounted on a shaft 365 which projects into the timer motor 352. Fixedly mounted to the shaft 365 there is provided a pulley 366 having secured thereto one end 367 of a string 368 which rides upon a rotatable pulley 369 and has secured thereto the indicator means 355, and rides over a second pulley 370, and the other end 371 of which is secured to a spring 372 attached to the backguard of the cabinet A. The spring is effective to provide proper tension and "give" to the string 368.

When the drier is in its inoperative position, the indicating means will be in the "off" position with respect to the dial 353. The operator may desire a drying time of forty minutes. Accordingly, the operator will rotate the control knob 33 which in turn will rotate the pulley 366 so that the string will wind thereupon and pull the indicating means 355 to its position indicating forty minutes on the dial 353. Rotation of the control knob 33 will also wind up the clock spring motor in the timer 352. In operation, the clock spring motor will then cause rotation of the shaft 365 in the opposite direction, thereby unwinding the string from the pulley 366 and, by virtue of the tension of the spring 372, the indicating means 355 will be drawn in a direction toward the "off" position. After the forty minutes have transpired, the indicating means 355 will reach the "off" position and the timer 352 will then open the switch 375 (Fig. 18) to open the circuit and shut off all operating elements of the drier.

Thus, it can be seen that the operating controls comprising the timer mechanism J are located on the backboard panel of the cabinet A, and the control dial 353 is illuminated as soon as the time control knob 33 is rotated by the user to set the control mechanism for a desired time interval of operation. Definite time is used to control

the operation of the drier with the time indications marked in groups of ten minutes up to sixty minutes, broken down with markings at five-minute intervals. After the five-minute interval indicators are the wordings "Damp" and "Dry" for selecting drying time for either. Beyond the indicated sixty minutes are further marks for operation up to two hours with the wording above "Heavy Fabrics" for articles that require additional drying time such as shag rugs, chenille bedspreads, etc. The knob 30 which operates the control switch 351 is also incorporated in the control panel and is operable for settings at the markings indicated on the dial 353 for "Heat" in drying or set at "Air" for drying with no heat.

WIRING DIAGRAM AND ELECTRICAL CONTROLS

Attention is invited to Fig. 18 wherein there is diagrammatically illustrated a wiring diagram for a clothes drier contemplated herein. Although there is shown an electric heater 202, it is obvious that this heater may be substituted by gas or any other convenient means effective to heat the ambient air entering in the drum B.

The drier contemplated by this invention may be equipped with an ozone or germicidal light 390 (Figs. 3, 4 and 18) which is mounted on the drum rear bearing vertical support bracket 145 as shown and with the light extending through an opening 391 in the cylinder support bracket 145. With the light mounted in this location, a considerable amount of air is drawn in and around the light at all times during the operation. This provides maximum efficiency of the ozone or germicidal light.

Wired in series with the ozone or germicidal light is a standard 40 watt light bulb 392, also mounted on the support bracket 145 as shown and which acts as a choke coil and both the ozone or germicidal light and the standard 40 watt light bulb are wired in series with the door switch 114 and the timer switch 375.

The door switch 114 (Figs. 1 and 18) is mounted on the front panel 21 at the upper left-hand corner of the clothes door opening 26. The switch 114 is actuated by contact with the door.

When the door 25 is opened, the switch 114 opens the electrical circuit which is effective to stop the drier and simultaneously therewith turn on the cylinder light 113 (Figs. 4, 6, 8 and 18). When the door 25 is closed, the operation of the drier is resumed and the light 113 is turned "off."

It is notable that the drier contemplates operation at relatively low temperatures ranging between 110°F. and 140°F. In order to accomplish this operation, there is provided a non-adjustable thermostat 395 which is operable to maintain a drying level

of approximately 110°F., and is preferably located in the right-hand corner of the lint duct, accessible by tilting the lint trap access door 37.

In addition to maintaining a drying level 110°F., the thermostat 395 limits the temperature to a maximum of 140°F.

The difference between drying level and maximum level is the sustained drying level at 110°F., and as the clothes become drier and the final moisture is removed from the clothes the temperature will rise to a maximum of 140°F., which will cause operation of said thermostat 395 to open the circuit and shut off the heater 202.

Normally, the maximum temperature is reached several minutes before the end of the drying cycle when the clothes are completely dry and the heat will remain off for this short period of time to allow the clothes to cool slightly for removal from the drier.

In order to provide additional safety, there is disposed in the electrical circuit a high limit thermostat 397 (Figs. 3, 4 and 18) mounted in the top of the heat chamber 201, directly above the heating element 202.

The high limit thermostat 397 is non-adjustable and is set to open the circuit at 200°F. and to close the circuit at 150°F. This thermostat switch resets automatically and is wired in series with the heater element 202, and if the temperature in the drum B becomes unduly high the switch will break the circuit to the heating element 202 and will continue to cycle "off" and "on" until the cause is corrected.

Preferably, the heating element as illustrated may be a 4200 watt element at 220 volts. A three-wire 398, 399 and 400 power connection is required. The third wire enables the power to be divided so that a standard 115 volt motor may be advantageously employed to drive the drum B and the fan C.

A separate switch 405 operated by a relay 406 is used to energize the heating element 202 because the timer contacts are normally not sufficient to carry 220 volts. When the timer is set to "on" this energizes the relay 406 connected to the plunger 407 of the electric element switch 405 to operate said switch. The relay 406 is wired through the starting switch 408 of the motor 135. The relay 406 normally is not energized unless the motor 135 is in the running winding.

SUMMARY OF OPERATION

The clothes drier contemplated herein is an indoor clothes drier advantageously applicable for domestic use in homes, apartment buildings and self-service laundries. It will damp dry an average eight to nine pound load of clothes (dry weight) ready for ironing in approximately thirty minutes. It will completely dry an average

washer load of clothes in approximately forty-five minutes.

The wet clothes are placed into the solid, smooth drum B which revolves at 45 RPM, gently tumbling the clothes by means of three smooth baffles as at 74 disposed within the drum B.

The clothes are dried by air which is drawn through a number of openings 205 in the back panel 206 and through other openings to come in contact with the air heating element 202. The heated air is then forced by pressure from the fan assembly C through the three ducts as at 73 provided in the rear wall of the drum B, into the drum B proper and circulated over and through the clothes contained therein. The heated moisture-laden air is then expelled through the relatively small openings 90 in the drum front wall where it is directed down through an air duct 91, through the lint screen 281 of the lint trap means G and into the exhaust duct H. This type of circulation allows the use of a relatively high volume of air, resulting in an over-all cooler unit and increased efficiency due to less heat leakage.

Clothes of the most delicate fabrics may be dried in the drier contemplated herein by means of air only, or by air with heat. This is accomplished by employing the heat switch 361 controlled by the knob 30 whereby the heating element is turned "off" when the switch is set at "Air" and the heating element will operate when the switch is set at "Heat" to provide air with heat.

When drying items such as pillows and similar articles which cannot stand any great amount of tumbling, the drum B may be stopped from revolving with the heat "on" and, after a short period of time or whatever time is deemed necessary, the drum B may be caused to rotate for approximately five minutes to fluff the article.

The drum B may be stopped by means of the static drive mechanism E which is operable to lift the drum B up off the drive pulley 124. The static drive mechanism E is operated by a handle 240 located at the lower left-hand corner of the drier, in back of the lint trap access door 37. Turning the handle 240 clockwise lifts or stops the drum B. Turning the handle counterclockwise lowers the drum B on the drive pulley 124 and starts the drum B revolving.

In general, the operation of a drying cycle may be accomplished as follows:

1. The fabrics may be placed in the drier as they come from the washing machine. The door 25 is then closed;
2. The heat switch knob 30 is set to "Air" or "Heat" as desired;
3. The drier is started by rotating the time control knob 33 for the desired drying period;

4. The drier will automatically shut off at the end of the selected drying period. To stop the drier before the end of the selected drying time, the time control knob 33 may be rotated counterclockwise until the indicator pointer 361 of the indicator means 355 is at the "Off" position or the clothes door 25 may be opened to cause operation of the door switch 114; and

5. If the fabrics comprise a mixed load, lightweight items will dry faster and may be removed at any time when ready for ironing by stopping the drier operation as aforesaid. Operation may be resumed for heavy articles by rotating the time control knob 33 to the required time necessary to effectively dry such heavy articles.

It is notable that the drier contemplated herein is specifically designed and may be equipped with provisions so that the moist heat-laden air can be exhausted in any one of five different directions, namely, left or right side of the cabinet near the rear of the drier, directly in the rear of the cabinet, downwardly through the bottom wall of the cabinet, and exhausting can be directed into the room through the front of the drier by tilting the lint trap access door 37 to its open position shown in dotted lines in Fig. 10. In the closed position the lint trap access door 37 seals and closes the lint screen opening and serves as a toe plate since it is recessed at the bottom of the cabinet.

The door switch 114 is mounted on the front panel 21 in the upper left-hand corner of the clothes door opening 26. The switch 114 is actuated by contact with the door 25. When the door 25 is opened, the switch 114 will automatically stop the drier and turn on the lamp 113 to illuminate the interior of the drum B. When the door 25 is closed, the operation of the drier is resumed and the lamp 113 is turned off.

The drying temperature is controlled by the thermostat 395 which is non-adjustable and effective to maintain a drying level of approximately 110°F. In addition to maintaining a drying level of 110°F., the thermostat 395 limits the temperature to a maximum of 140°F.

The difference between drying level and maximum level is the sustained drying level at 110°F., and as the fabrics contained in the drum B become drier and the final moisture is removed from the fabrics, the temperature will rise to a maximum of 140°F.

In order to provide additional safety, there is disposed in the wiring circuit a high limit thermostat 397 which is mounted in the top of the heater housing directly above the air heating element 202. The thermostat 397 is non-adjustable and is set to open the circuit at 200°F., and to automatically reset itself at 150°F. Moreover, the thermo-

stat 397 is wired in series with the air heater element 202 and, if the temperature in the drum B becomes unduly high, the thermostat 397 will break the circuit to the air heating element 202 and will continue to cycle "off" and "on" until the cause is corrected.

The drum B and the fan assembly C is supported in the drier cabinet by a single rear bearing 146 mounted on the bearing support 145 and at the front of the drier by a rubber idler pulley 120 at the right front, and a rubber drum drive pulley 124 at the left. The front outside circumference of the drum B rests on both of the above pulleys and is driven by friction from the drive pulley 124 which in turn is keyed to a shaft 125 extending to the rear of the drier. The drive shaft 125 is driven by a pulley 130 attached to the shaft 125 at the rear of the drier and a connecting drive belt 138 to the motor 135. The single belt 138 is effective to drive both the drum B and the air circulating fan C.

The air circulating fan C is located at the rear of the drum B, being housed in the drum B proper, and rotates freely on the drum central support shaft 82.

Preferably, rotation of the drum B is counterclockwise at 45 RPM.

Rotation of the fan is clockwise at approximately 600 RPM.

Thus, it may be seen that the drier contemplated herein is made of simple parts and readily available materials to lend itself to mass production manufacturing principles, thus affording a substantial saving in the manufacturing costs.

From the foregoing disclosure, it may be observed that we have provided an improved drier for fabrics and the like which efficiently fulfils the objects thereof as hereinbefore stated and which provides numerous advantages which may be summarized as follows:

1. Structurally simple, efficient and durable;

2. Economical to manufacture and readily adaptable to mass production manufacturing principles;

3. The provision of a clothes drier having incorporated therein means whereby the user may select to have the drum rotate to tumble the fabrics contained therein or cause said drum to be held stationary to effect a so-called "static dry" with a further selection by the user as to whether it is desired to have either heated air or room temperature air pass through the drum; and

4. The provision of a drier having

relatively low operating temperatures ranging from 110°F. to 140°F., with means to cause passage of a relatively large volume of air through the drum under pressure and constantly away from the heating means whereby to eliminate hazards and dangers of firing of the fabrics contained in the drum.

What we claim is:—

1. A clothes drier including a rotatable clothes-receiving drum having a substantially imperforate cylindrical shell open at one end for the insertion and removal of the clothes, the other end of the drum being closed by a wall which is formed to define a plurality of air scoops around an annular air chamber formed by axially spaced portions of the wall, each air scoop having an inlet opening for establishing communication between the annular air chamber and the interior of the drum, whereby upon rotation of the drum in a predetermined direction the wall scoops a number of separate air streams from the annular air chamber into the interior of the drum.

2. A clothes drier according to claim 1, wherein said end wall is formed with a number of spirally extending baffle portions which cooperate with the cylindrical drum shell to define the air scoops.

3. A clothes drier according to claim 1 or 2, wherein an obstruction is mounted in each of the inlet openings to the air scoops to prevent articles of clothing from escaping from the drum through the air scoops.

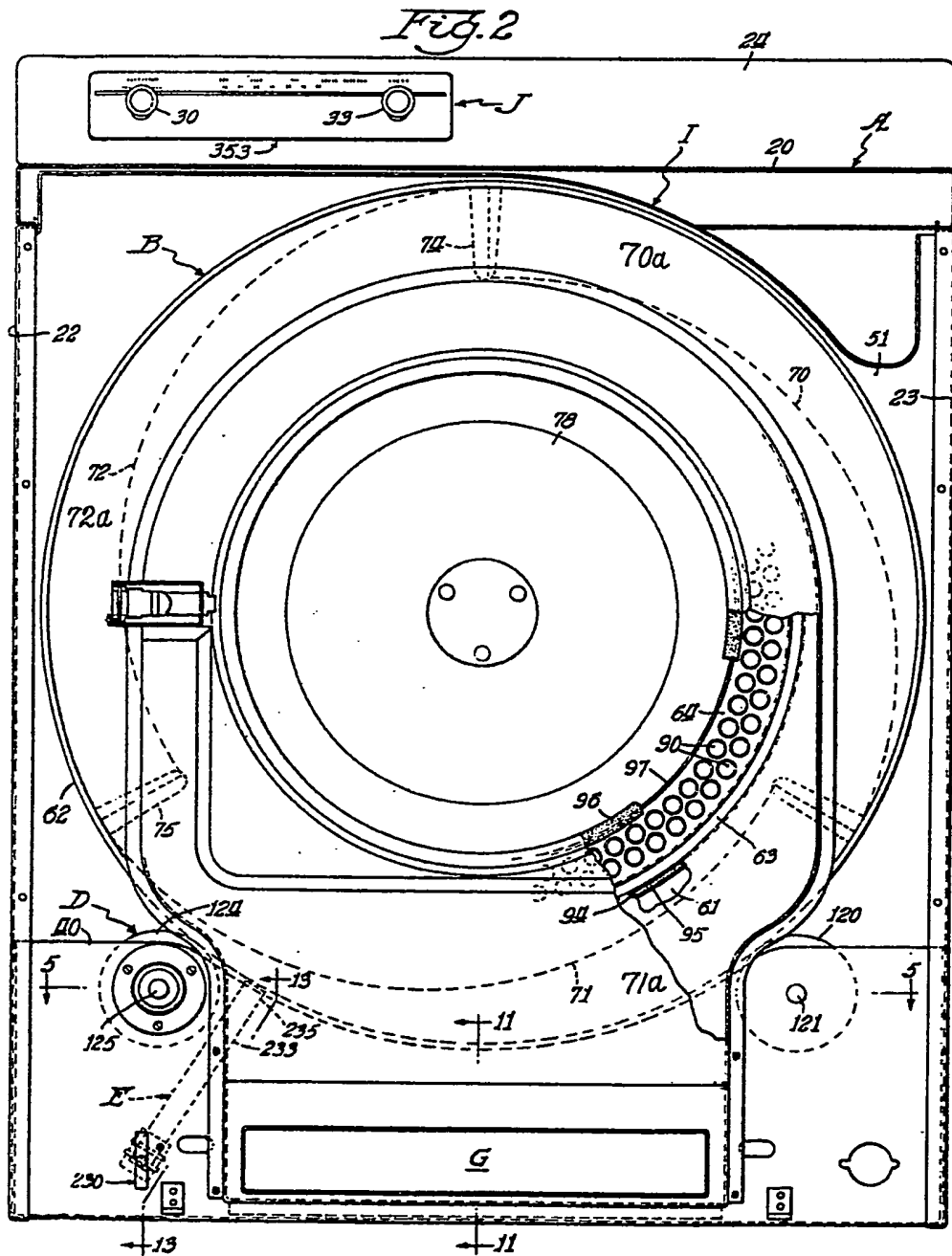
4. A clothes drier according to claim 1, 2 or 3, wherein a radially inwardly directed, axially extending baffle vane is mounted on the interior of the drum shell substantially in alignment with the end of each scoop situated opposite the inlet opening.

5. A clothes drier according to any of the preceding claims, wherein a fan is accommodated in said annular air chamber, said fan and said drum being adapted to be driven in such directions of rotation that the air scoops assist the fan in conveying air into the interior of the drum.

6. A clothes drier including a rotatable drum that is constructed and adapted to operate substantially as herein described with reference to the accompanying drawings.

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& ROLLINSON,

Chartered Patent Agents,
Agents for the Applicants.



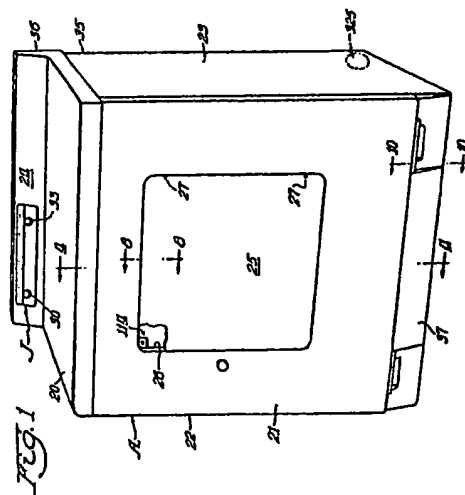
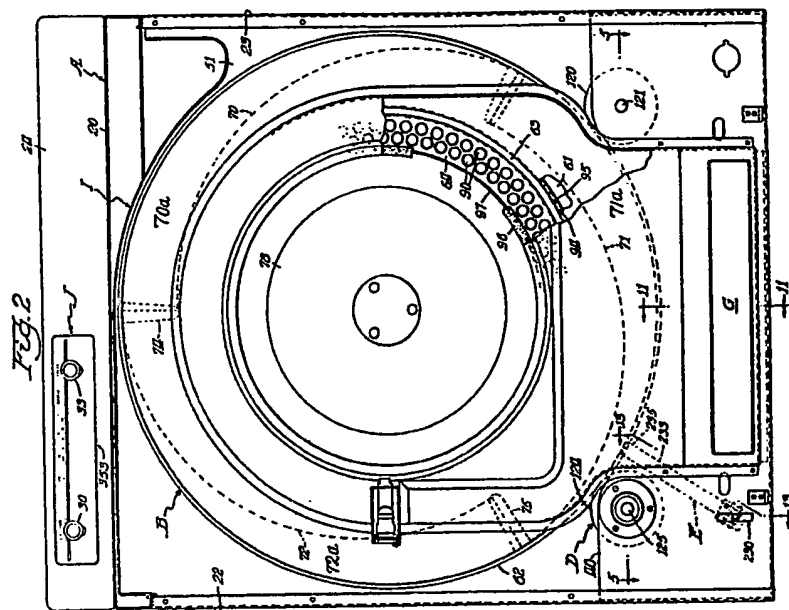
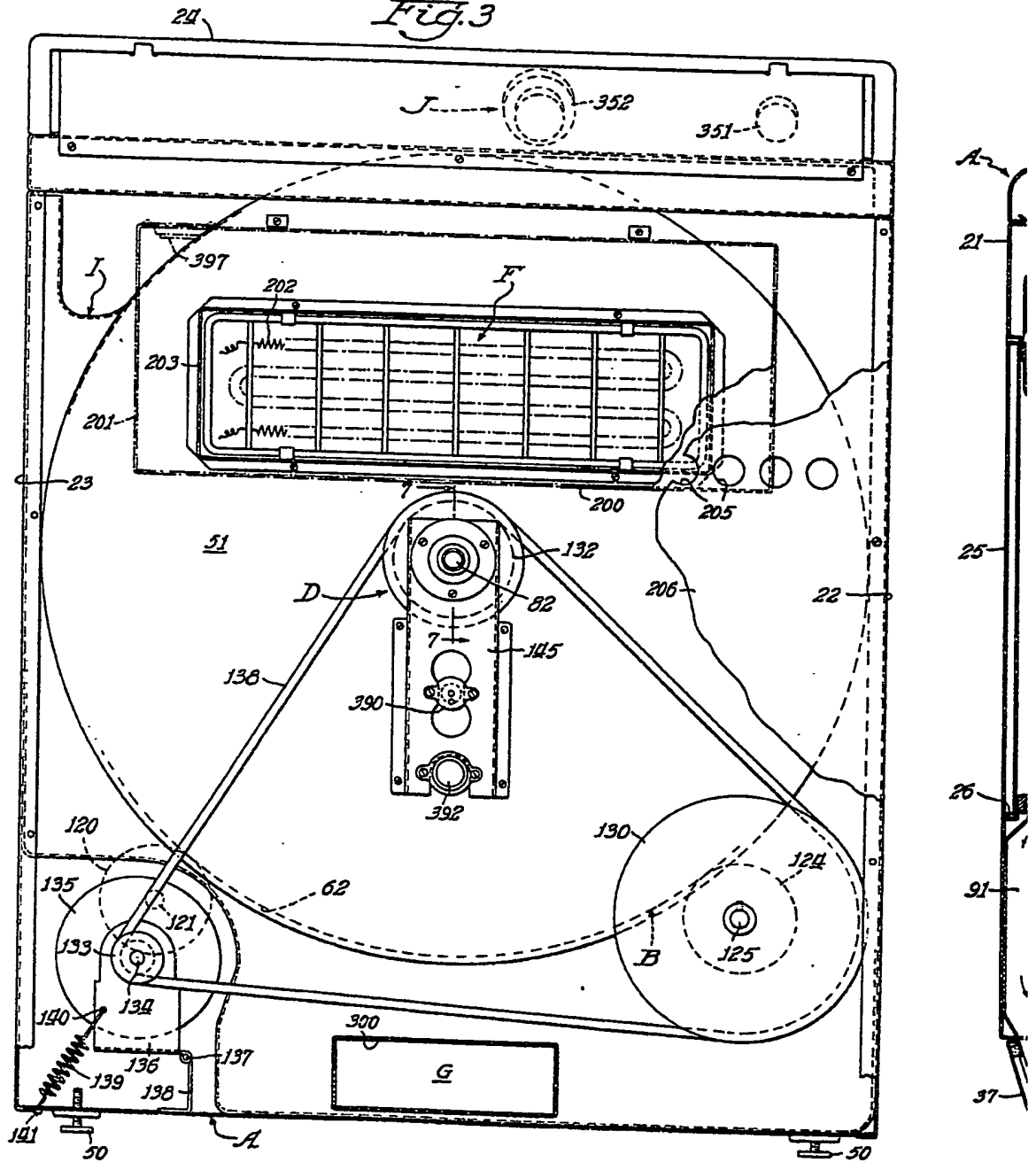


Fig. 3



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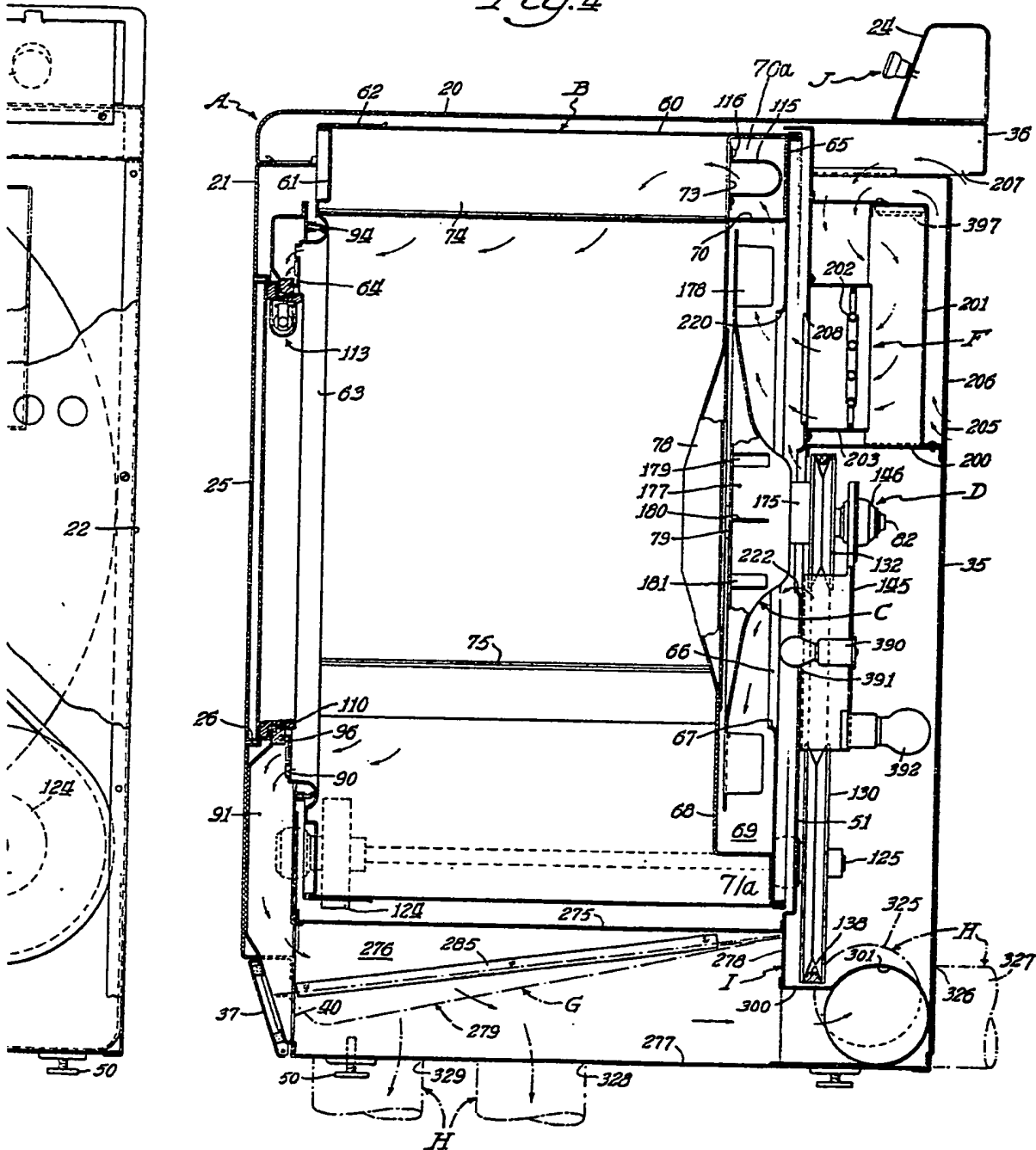
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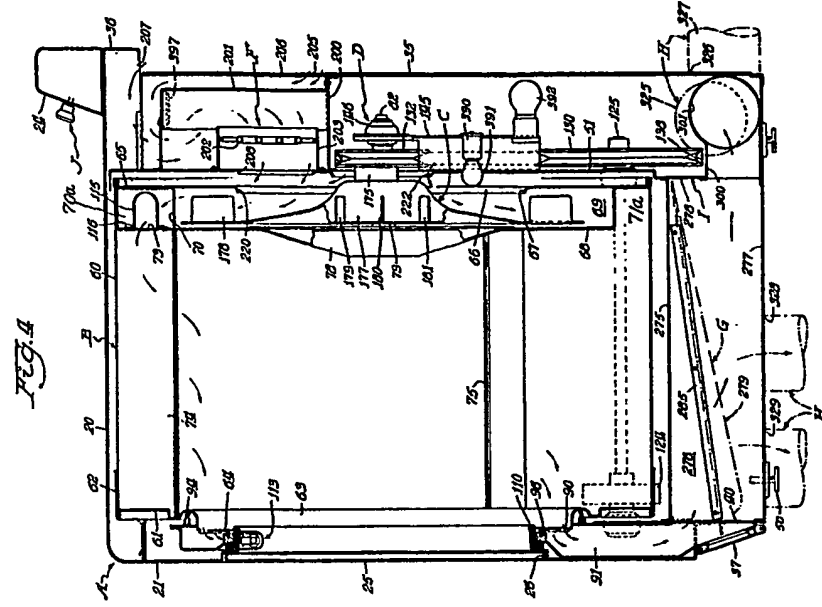
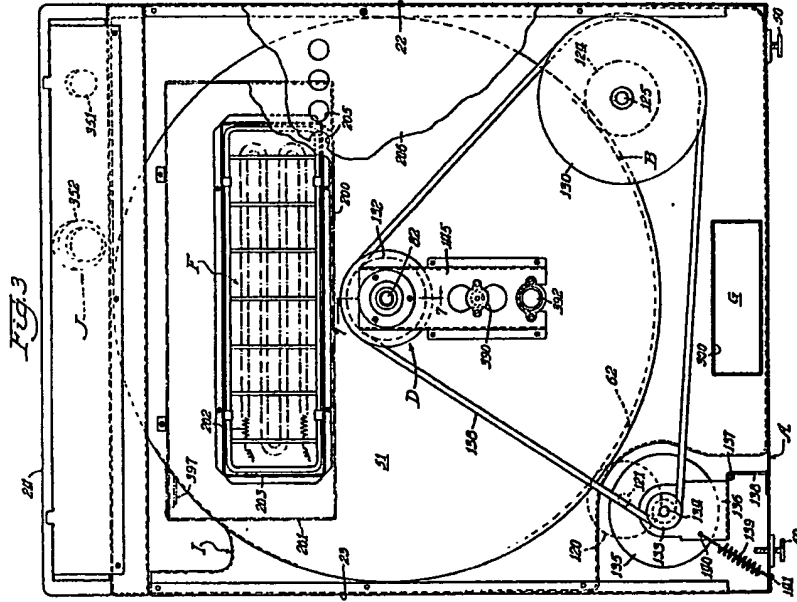
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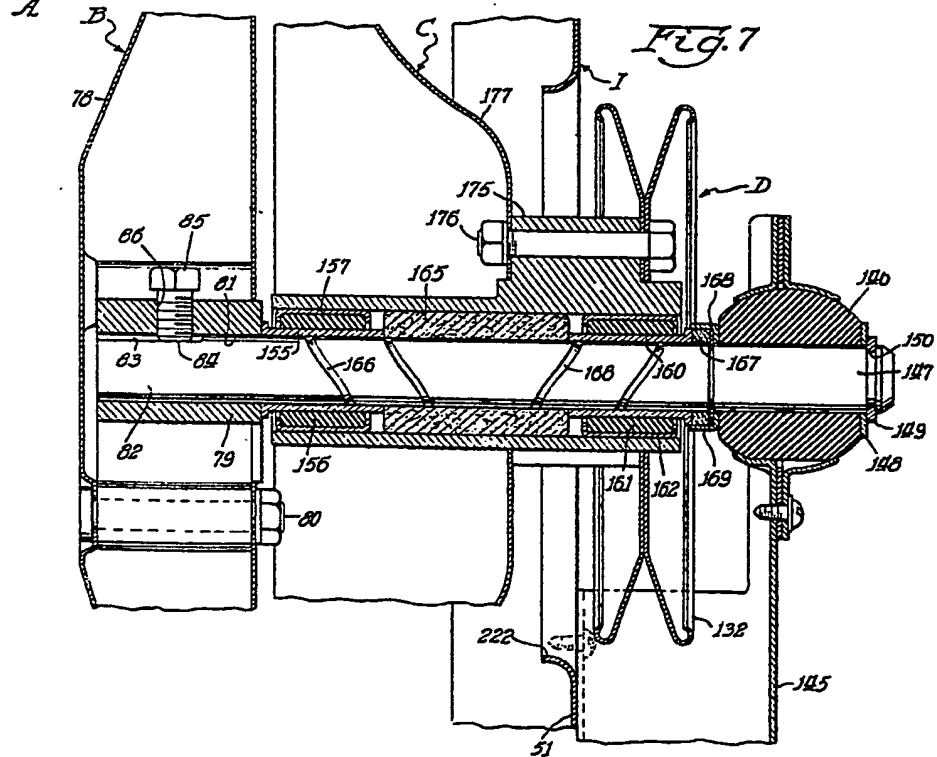
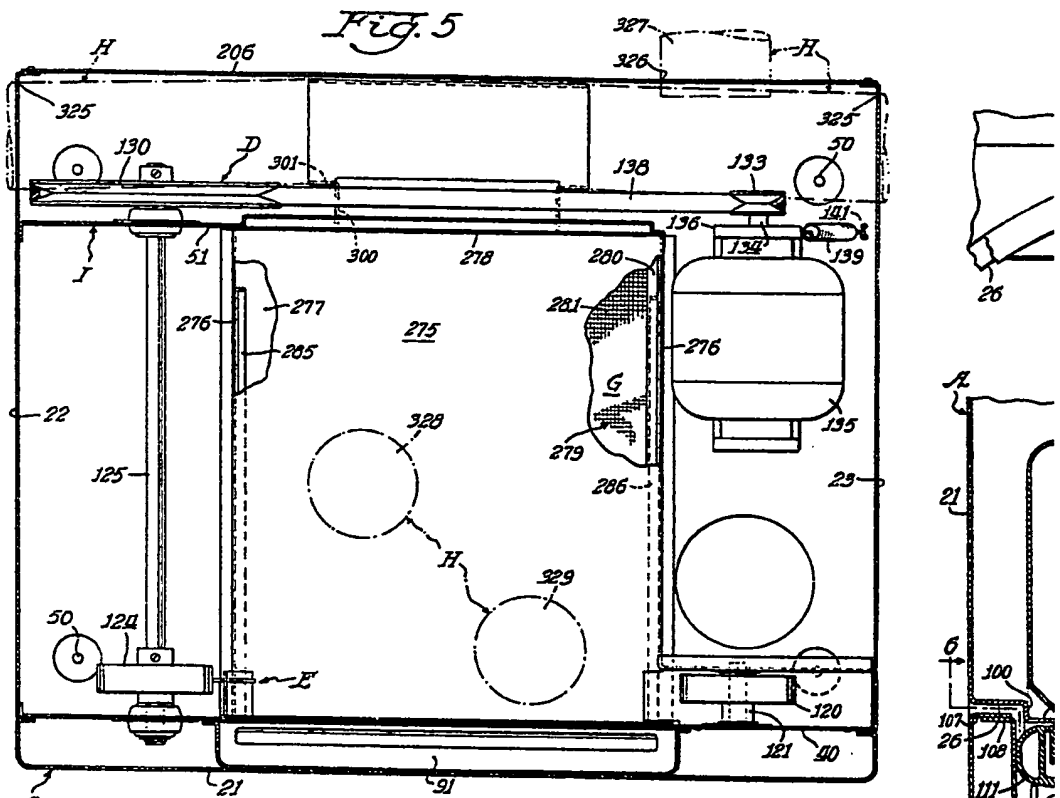
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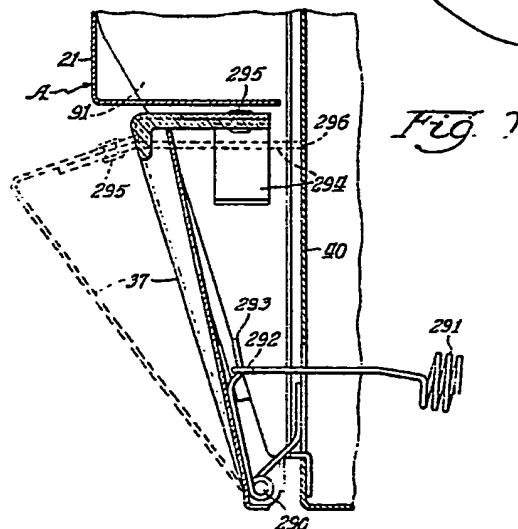
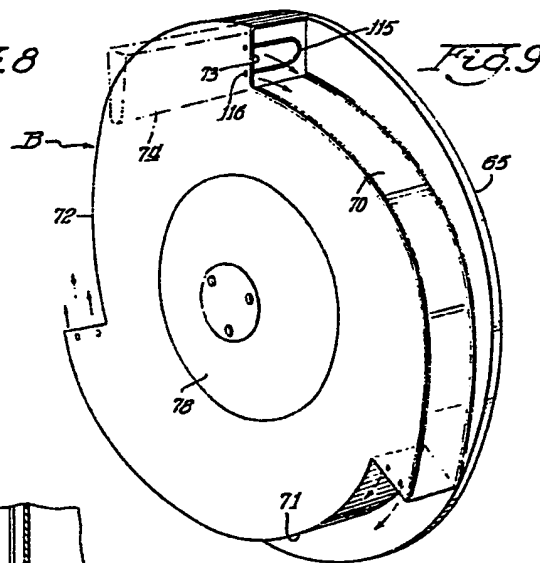
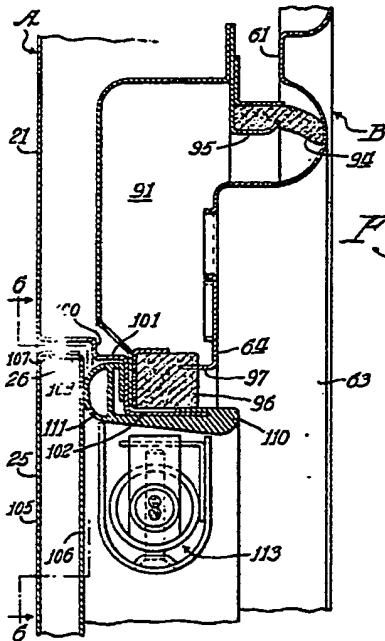
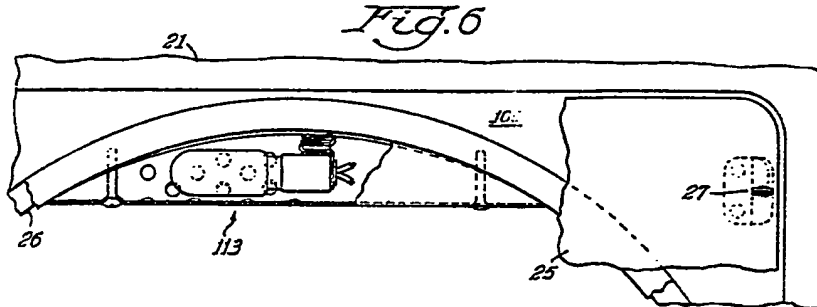
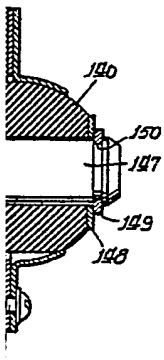
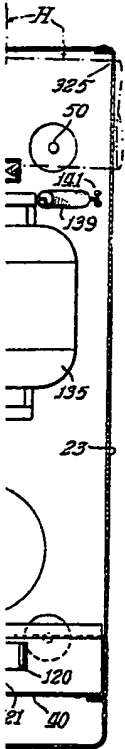
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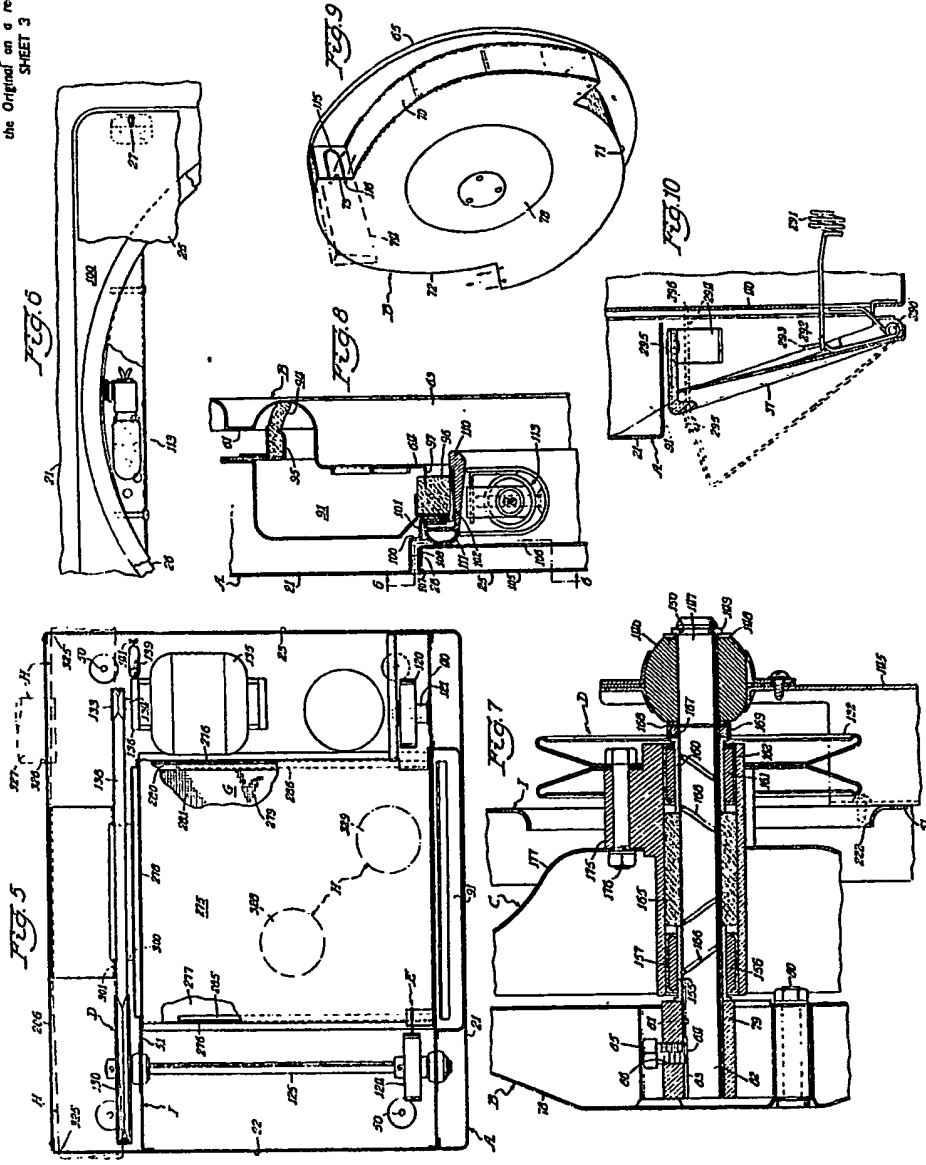
FIG. 4

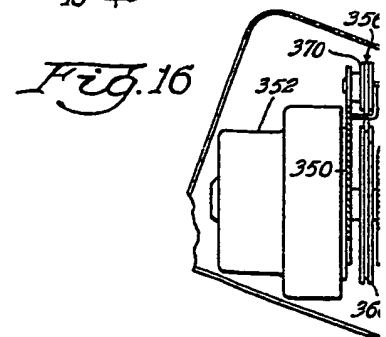
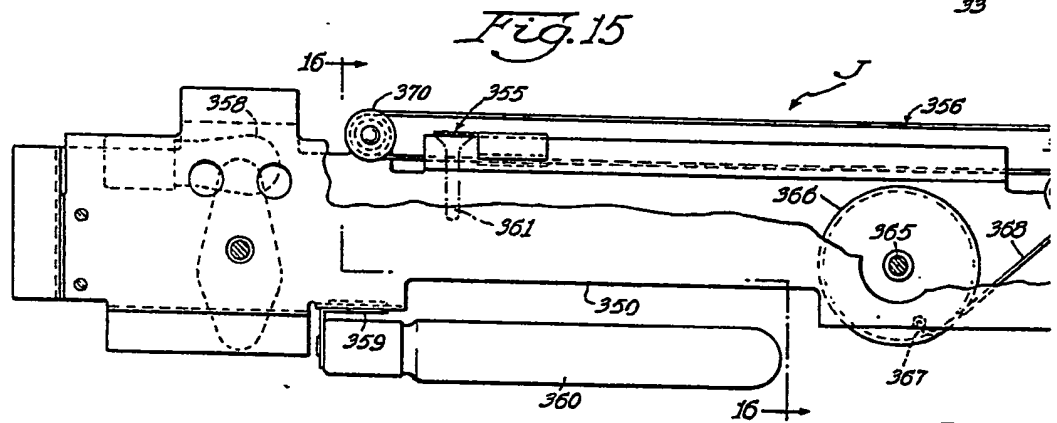
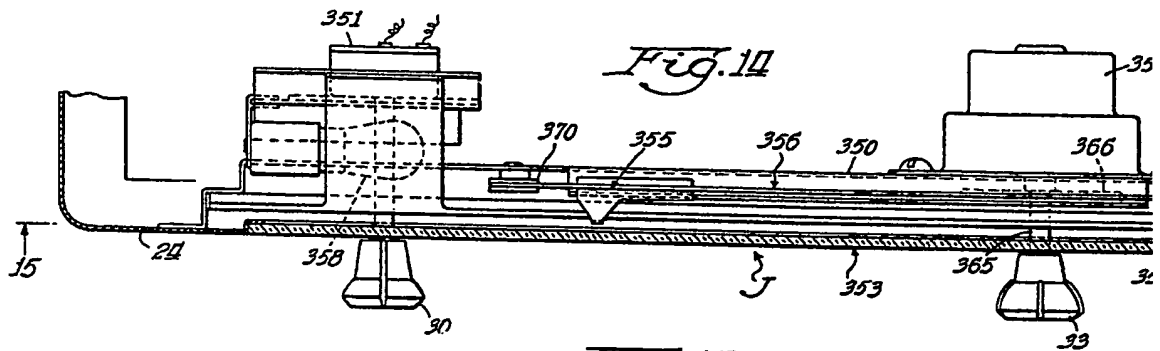
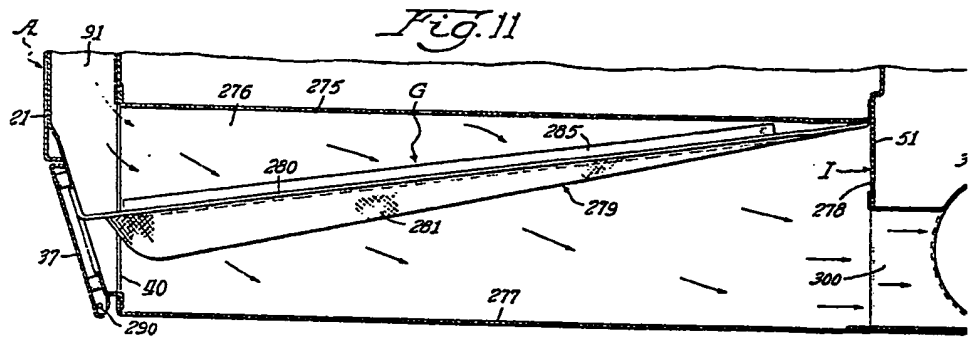










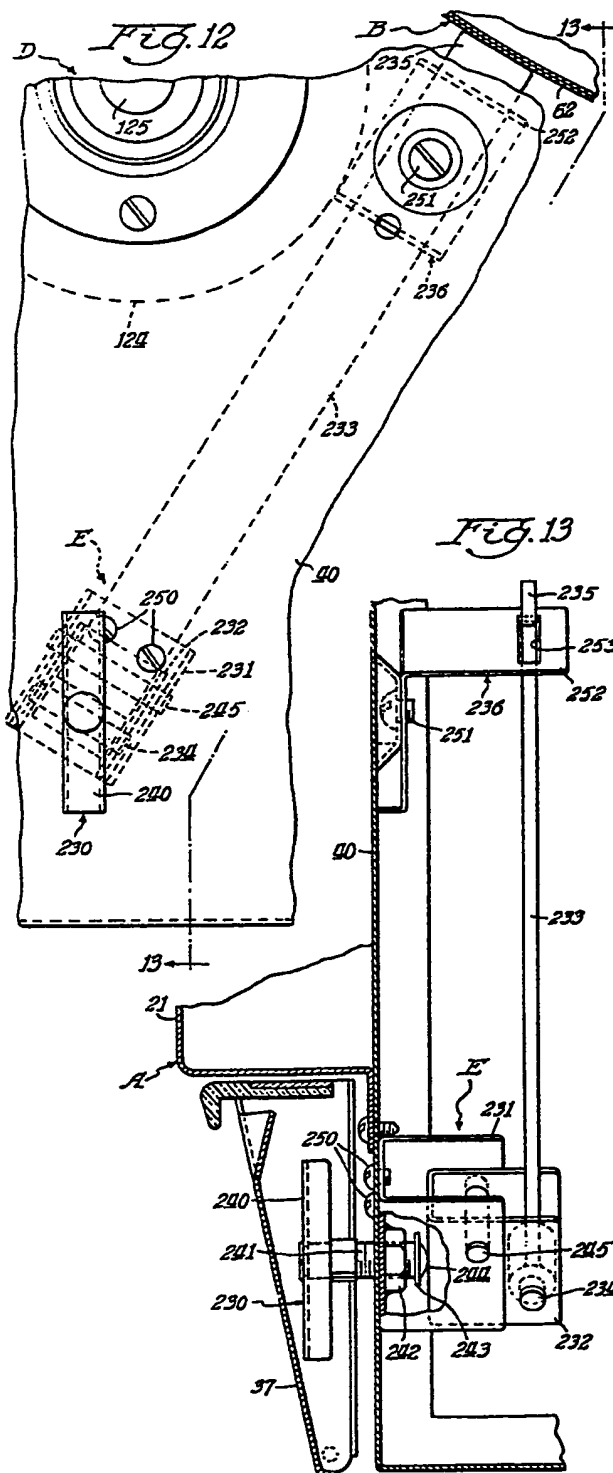
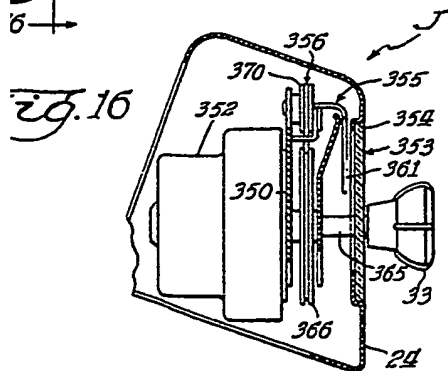
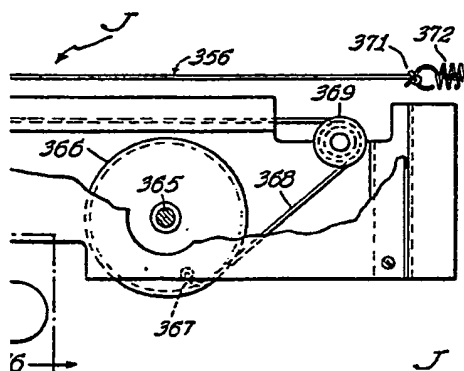
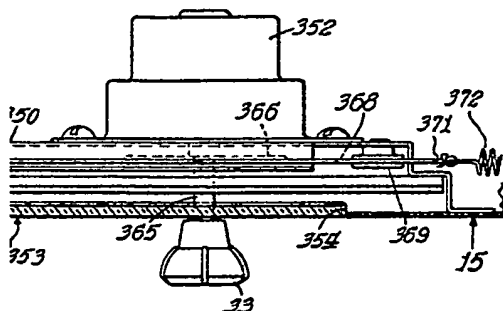
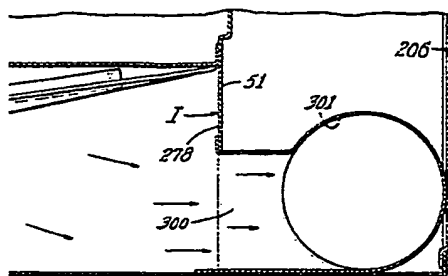


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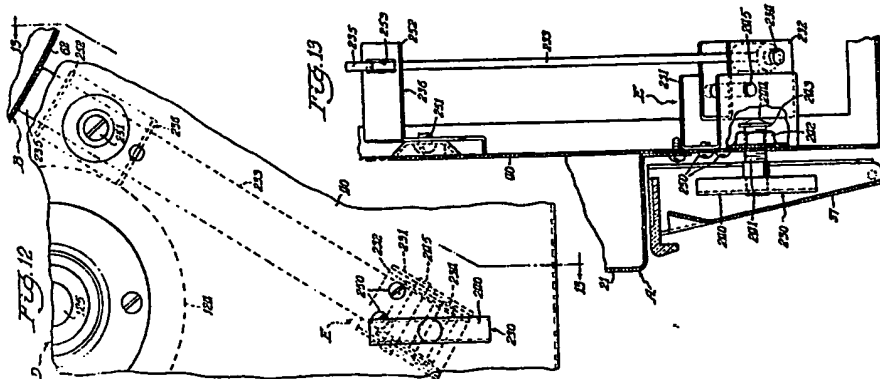
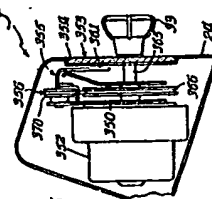
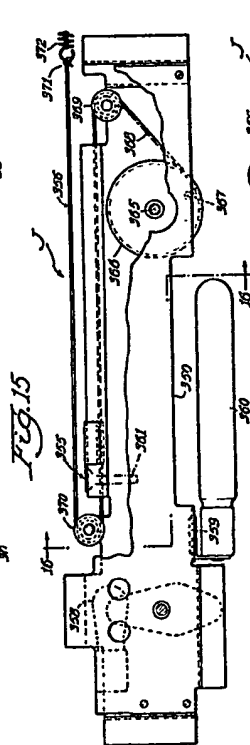
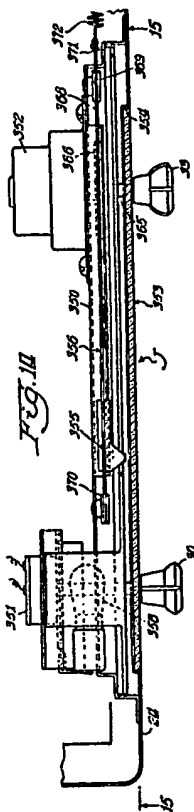
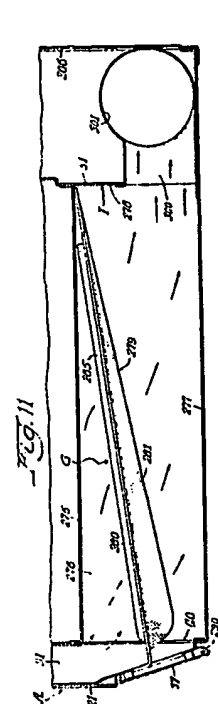


Fig. 17

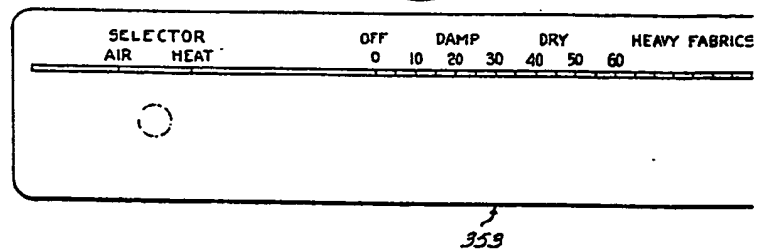
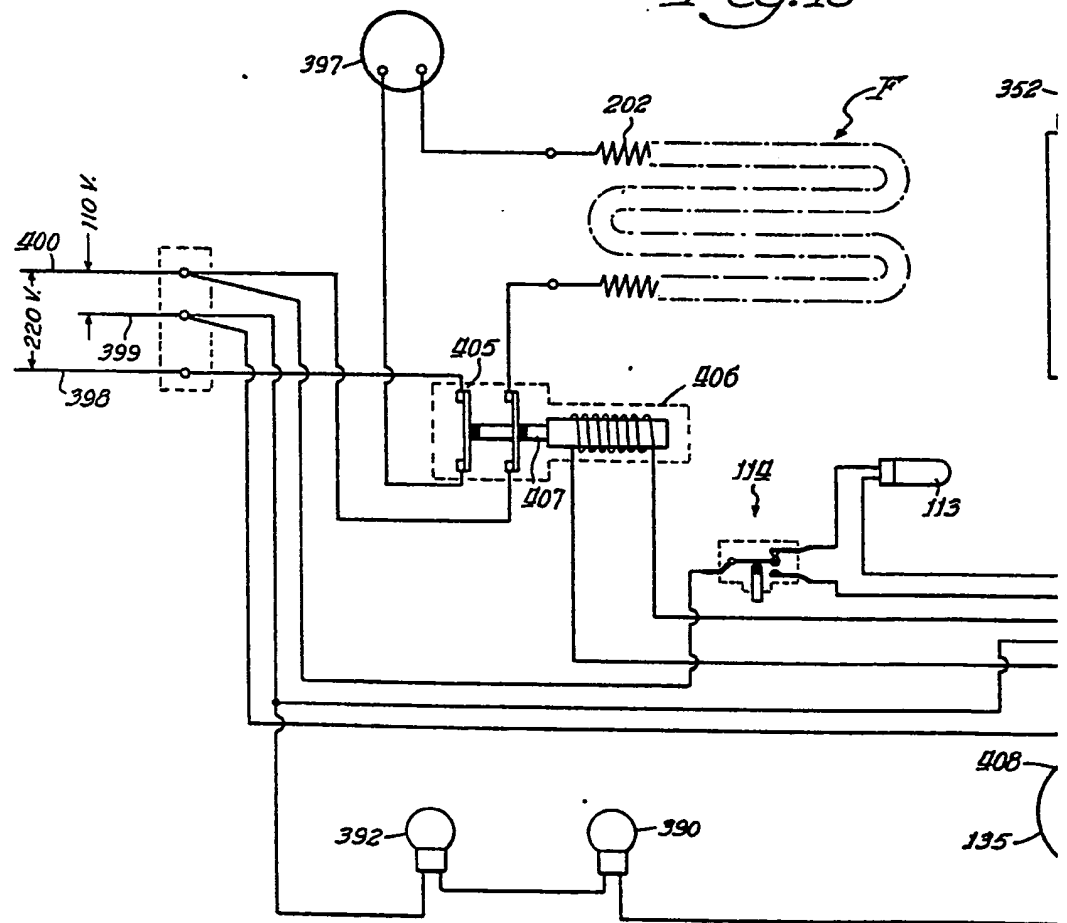


Fig. 18



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Fig. 17

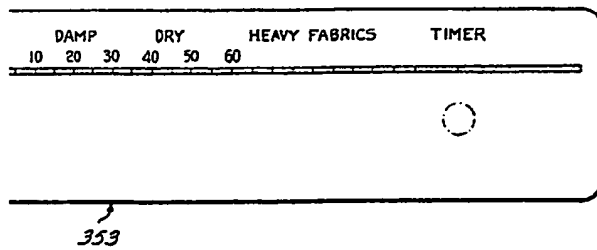


Fig. 18

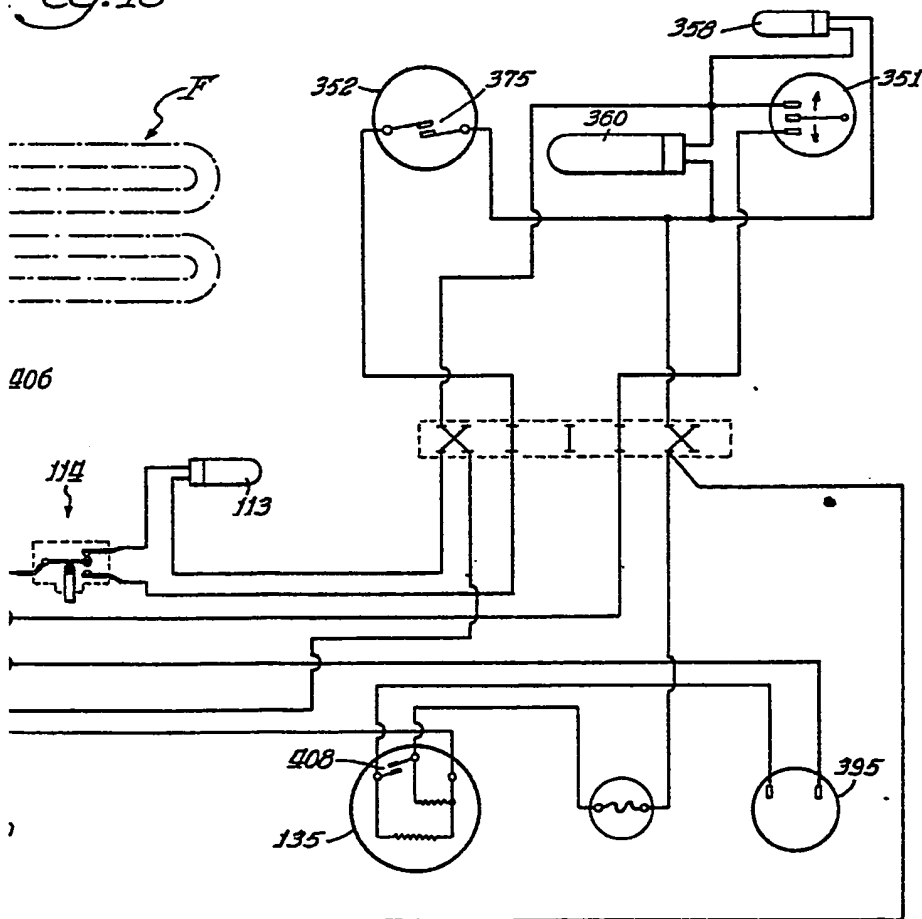
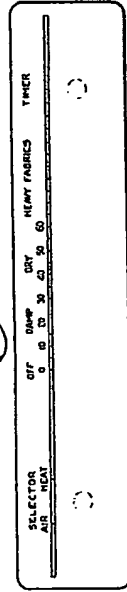
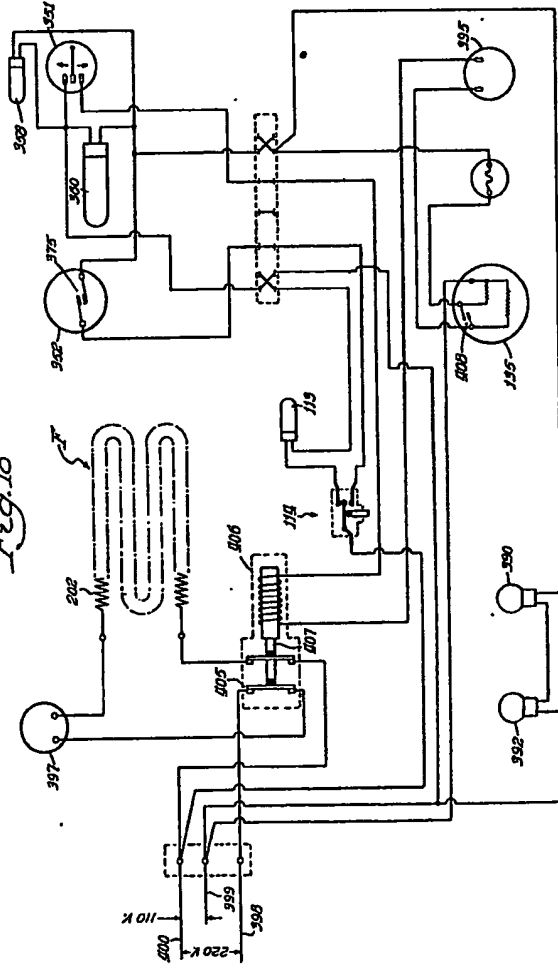


Fig. 17



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Fig. 18



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